Organizing the Global Value Chain: a firm level test

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Abstract

In the last two decades, technological progress and a decrease in trade barriers allowed the emergence of global value chains, in which different sequences of production stages, previously performed in close proximity, can now be unbundled globally (see among others, Baldwin and Venables, 2013). Most of these production processes involve a sequential trading chain stretching across many countries, with each country specializing in particular stages of a good's production sequence (Hummels et al., 2001). In this respect Antràs and Chor (2013) develop a theoretic model to shed light on the sequentiality of production stages as dependent on the nature of contractual relationships between final-good producers (parent firms) and intermediate inputs suppliers (affiliates). The model outlines the optimal allocation of ownership rights along the value chain as function of the relative position at which the supplier enters the production line, and the elasticity of demand faced by the final-good producer. The central result of their model is that the contractual frictions are relevant for both the productive efficiency and the way in which production stages are organized across national borders. Having this background in mind the aim of the paper is to empirically investigate, from a firm level perspective, how the parent' relative position along the value chain (downstreamness) affects the choice to integrate different affiliates when also demand elasticity is taken into account. Exploiting a unique dataset of 4.000 parents controlling a total of about 100.000 affiliates all over the world, we find empirical evidence of significance of both parent's downstreamness (Alfaro and Charlton, 2009) and demand elasticity in global value chains'organization.

Keywords: *Global value chains, business groups, vertical integration, property rights theory, multinational enterprises, downstreamness.*

JEL codes: *F14, F23, D23, G34, L20.*

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1 INTRODUCTION

This contribution tests for the organization of Global Value Chains (GVCs) by multinational enterprises as sequences of production processes that are subject to contractual frictions. In the last two decades, technological progress and a decrease in trade barriers allowed the emergence of cross-border sequences of productive tasks undertaken by firms along virtually international assembly lines. From the product design to the distribution to the final consumer, all intermediate stages of production can involve networks of firms that are dispersed in several countries. Each firm's task can be organized in two alternative ways, either under the coordinated management of common headquarters, in the case of vertical integration performed by multinational enterprises (MNEs), or through a supply contract (i.e. arm's length contract).

Previous works already investigated the determinants of cross-border vertical integration, as giving rise to intra-firm transactions. Among others, Antràs (2003) explained why intra-firm trade is mainly concentrated in capital intensive industries and between capital abundant countries. Antràs and Helpman (2004), in a context of heterogeneous firms, argued that only the most productive firms are able to sustain the higher sunk costs of international vertical integration, and that would explain a positive relationship between intra-firm trade and productivity dispersions[1]. With a broader perspective, Acemoglu et al. (2007) considered the possibility that unique headquarters commit contracts with various suppliers. They showed that greater contractual incompleteness leads to the adoption of less advanced technologies, even more when intermediate inputs are highly complementary.

Our analysis is based on a more recent theoretical framework proposed by Antràs and Chor (2013) (henceforth AC (2013)), where the authors rather depict a property-rights model of MNEs boundaries, dissecting the optimal allocation of ownership rights in a context where production processes are sequential in nature and contracts between a final good producer and its suppliers are all potentially incomplete. Compared to previous works, they introduce a technological ordering of production stages, so that one stage can commence only when intermediate inputs from upstream stages are complete. This is a noteworthy advance in the comprehension of the organization of GVCs, since their theoretical setting is capable to proxy a productive environment in which a firm and its suppliers have to bargain sequentially, but on the basis of the surplus that can derive from sales of final products after the completion of the supply chain. Each supplier undertakes a relation-specific investment in order to provide a customized input that is partially non-contractible. This contractual incompleteness leads the final good producer which own the residual rights of controls to enhance its bargaining power in case of a contractual breach, but owning (i.e. integration) reduces the incentives of suppliers to invest in the relationship. Further, there exists a dependence among all production stages because the relation-specific investment made by suppliers in upstream stages affects also the incentives of suppliers in downstream stages. If an investment made by a supplier increases the value of the marginal product perceived by downstream suppliers (i.e. when the elasticity of final-good demand is higher than the value of the elasticity of substitution across different inputs) their production stages are called sequential complements. On

[1] For a review of organization and trade, see Antràs and Yeaple (2014).

the other hand, if a supplier faces diminishing values (when the demand price elasticity of the final good is sufficiently low) we have the case of sequential substitutes. Therefore, inputs are sequential complements (substitutes) only if the elasticity of final good demand is higher (lower) than the elasticity of substitution across the services provided by the different suppliers' investments.

Exploiting the Business Groups Approach (Altomonte and Rungi, 2013), for which the observation unit is a parent controlling affiliates located both domestically or abroad, the central result that we test in this work is the prediction that optimal patterns of vertical integration along the value chain depend on the magnitude of demand elasticity faced by parent firm and the degree of its downstreamness.

Consider for example the case of two Business Groups present in our dataset: Sony which is primarily focused on the electronics products manufacturing and Johnson & Johnson an American multinational medical devices and pharmaceutical goods manufacturer, that exhibit similar degrees of parent firm downstreamness, but face very different average demand elasticities and also very different integration propensities. Both groups have a similar size, as they control 405 and 353 affiliates respectively and still when looking at industrial activities, they are among the most downstream manufacturing parent firms (0.87 and 0.92) but buyers tend to be much less price sensitive in their demand for the former (elasticity=4.79) than for the latter (elasticity=12.72). Accordingly, these two firms are classified under the sequential substitutes and complements cases respectively, and, consistent with AC (2013) model, the mean affiliates' downstreamness is 0.50 for Sony and 0.71 for Johnson & Johnson[2](i.e. in sequential complement case, vertical integration, through M&A operations or greenfield investments, occurs downstream and if outsourcing is observed along the value chain, it necessarily takes place further upstream) (Tables 1 and 2).

Then, to the best of our knowledge, is the first time that a firm level dataset allows to control for the sequentiality in the production chains. As in Alfaro and Charlton (2009) we find that parent's downstreamness deeply affects its choice over affiliates to integrate. Furthermore, as in AC (2013), the higher is demand elasticity faced by parent firms close to the end of value chains, the closer are integrated suppliers. This corroborates the findings on how property rights theory well fits the nature of relationships along value chains.

The remainder of this paper is organized as follows. In Section 2, we summarize the key theoretical predictions of AC (2013) model. In Section 3, we describe the construction of the sample and the variables used in the analysis. Section 4 presents empirical specifications and results. Finally, Section 5 concludes.

[2]It is not hard to find examples of small size Groups which follow the same organizational pattern. Seachange international Inc., primarily active in computer and peripheral equipment manufacturing, controls 11 affiliates and has a downstream parent (0.92) that faces a relatively low demand elasticity (4.77). Ashok Leyland, an Indian automobile manufacturing, controls 10 affiliates and still has a downstream parent (0.94) but it faces a very high demand elasticity (84.19). Consistently with the above results the mean affiliates' downstreamness is realtively low for the former (0.53) and high for the latter (0.68).

2 Theoretical Background

Our empirical analysis is motivated by the theoretical predictions of AC (2013) model. In particular, we are interested in the following predictions:

1. The propensity towards vertical integration is an increasing function of sequential stages in the complements case, while it is a decreasing function in the substitutes case.

2. In the complements case, there exists a unique cutoff stage such that, all previous production stages are outsourced and all following stages are integrated within firm boundaries (viceversa in the substitutes case).

In what follows we briefly describe the math supporting these predictions.
AC (2013) is a model built on a partial equilibrium framework, inspired by the property-rights approach to the firm (Grossman and Hart, 1986; Hart and Moore, 1990) that permits an analysis of the optimal allocation of ownership rights along the value chain. The key novelty is the sequentiality nature of production processes (Acemoglu et al., 2007) such that one stage cannot commence until the previous stages are complete. Different stages, combined according to a CES aggregator, are indexed by $j \in [0,1]$, with a larger j corresponding to stages further downstream. Denoting by *x(j)* the quantity of intermediate inputs that supplier *j* delivers to the firm, then the output is

$$q = \theta \left(\int_0^1 x(j)^{\alpha} I(j) dj \right)^{\frac{1}{\alpha}} \tag{1}$$

where θ is a productivity parameter, $\alpha \in [0,1]$ captures the inputs' substitutability across stages, and *I(j) = 1* is an indicator function if input *j* is produced (0 otherwise)[3].
Parent firm faces an isoelastic demand curve across varieties, beacuse the final good is differentiated in the eyes of consumers

$$U = \left(\int (\varphi(\omega) q(\omega))^{\rho} d\omega \right)^{\frac{1}{\rho}} \tag{2}$$

where $\varphi(\omega)$ is the quality of a variety, $q(\omega)$ is its consumption in physical units and $\rho \in [0,1]$ is the consumer demand elasticity. Combining this preferences with the production function in (1), the total revenue obtained by the parent is

$$r = A^{1-\rho} \Theta^{\rho} \left(\int_0^1 x(j)^{\alpha} I(j) dj \right)^{\frac{\rho}{\alpha}} \tag{3}$$

where $A > 0$ is an exogenous industry-wide demand shifter.

[3] *I(j)* makes the production technology sequential in that downstream stages are useless unless the inputs from upstream stages have been delivered.

Once input has been produced and the firm has had the chance to inspect it, parties bilaterally negotiate over the incremental contribution to total revenue engendered by the particular supplier. The incremental contribution of supplier m is given by [4]

$$r'(m) = \frac{\rho}{\alpha}\left(A^{1-\rho}\Theta^{\rho}\right)^{\frac{\alpha}{\rho}} r(m)^{\frac{\rho-\alpha}{\rho}} x(m)^{\alpha}. \tag{4}$$

The first peculiar result concerns the effect of the value of production secured up to stage *m*. If $\rho > \alpha$ (i.e. *sequential complements* case, when demand elasticity is higher than inputs' elasticity of substitution) the effect is positive, that is to say higher investment levels by prior suppliers, as summarized in *r(m)*, increase the marginal return of supplier *m*'s own investment. Conversely, if $\rho < \alpha$ (*sequential substitutes* case), contribution choices are sequential substitutes because high values of upstream investments reduce the marginal return to investing in *x(m)*.

The property-rights approach entails contracts between parent and each of its suppliers are all potentially incomplete in the sense that inputs' compatibility cannot be verified by third parties. This results in the classical hold-up problem, viz the relation-specific investor cannot guarantee himself a sufficient share of the return through ex post bargaining and it is thus characterized by under-investment of both parties. Contractual incompleteness leads to different bargaining power across firms. Parents integrating suppliers, are able to extract a higher share of surplus from them, because the residual rights of control associated with integration allow the parent firm to take actions that enhance their bargaining power vis-à-vis the supplier (Grossman and Hart, 1986). Thus parent obtains a share $\beta(m)$ of the incremental contribution $r'(m)$

$$\beta(m) = \begin{cases} \beta_o, & \text{if the parent firm outsources stage } m \\ \beta_v > \beta_o, & \text{if the parent firm integrates stage } m \end{cases} \tag{5}$$

and the stage m supplier obtains the remaining share $1-\beta(m) \in [0,1]$ of $r'(m)$.
Then supplier m maximization problem is

$$\max \pi_s(m) = (1-\beta(m))r'(m) - cx(m) \tag{6}$$

such that supplier m's profit is naturally increasing in the demand level, A, the productivity Θ of the firm, and the supplier's bargaining share, $1-\beta(m)$, while it decreases in the investment cost, *cx(m)*. Therefore, parent firm opting for outsourcing in stage m (low $\beta(m)$), clearly incentivize the supplier to invest in the relationship. However, as summarized in *r'(m)* in (4), the dynamic effects on these incentives still persist and strictly depends on the values of ρ and α. Intuitively, when demand elasticity ρ is higher than inputs' elasticity of substitution α (sequential complements case), the parent firm chooses to ousource upstream stages in order to incentivize the suppliers investment effort, since this generates positive spillovers on the

[4] Applying Leibniz's integral rule to equation (3) and taking into account that at this stage *I(j) = 1* for all $j < m$.

investment decisions to be made by downstream suppliers (dynamic effect). Furthermore, although integration allows the firm to capture some rents, the incremental surplus over which the parent firm and the supplier negotiate is particularly small in these early stages of production. When $\rho < \alpha$ (sequential substitutes case), outsourcing is, instead, particularly costly in early stages because high investments at this point of the value chain, lead to reduced incentives for downstream suppliers, whereas a low value of ρ, corresponding to a relatively high market power for the firm, leads to high weight on the rent-extraction motive for integration.

In order to validate the above findings for the whole sequence of stages, we have to analyze the equilibrium investment levels of all suppliers along the value chain, plugging *x(m)* of profit maximization (6) in equation (4) to obtain

$$r'(m) = \frac{\rho}{\alpha}\left(\frac{(1-\beta(m))\rho\Theta}{c}\right)^{\frac{\alpha}{1-\alpha}} A^{\frac{\alpha(1-\rho)}{\rho(1-\alpha)}} r(m)^{\frac{\rho-\alpha}{\rho(1-\alpha)}} \tag{7}$$

that is a differential equation in *r(m)*. Solving[5] this yields to

$$r(m) = A\left(\frac{1-\rho}{1-\alpha}\right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \left(\frac{\rho\Theta}{c}\right)^{\frac{\rho}{1-\rho}} \times \left[\int_0^m (1-\beta(j))^{\frac{\alpha}{1-\alpha}} dj\right]^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \tag{8}$$

and to determine investment level *x(m)* plug this solution into equation (6)

$$x(m) = A\left(\frac{1-\rho}{1-\alpha}\right)^{\frac{\rho-\alpha}{\alpha(1-\rho)}} \left(\frac{\rho}{c}\right)^{\frac{1}{1-\rho}} \Theta^{\frac{\rho}{1-\rho}} (1-\beta(m))^{\frac{1}{1-\alpha}} \times \left[\int_0^m (1-\beta(j))^{\frac{\alpha}{1-\alpha}} dj\right]^{\frac{\rho-\alpha}{\alpha(1-\rho)}} \tag{9}$$

which, again, shows how outsourcing of stage m (i.e., $\beta(m) = \beta_o$) enhances investment by that stage's supplier, while the dependence of *x(m)* on upstream suppliers is deduced by their organizational structure $(1-\beta(j))$ but crucially on ρ and α.

The optimal pattern of ownership is, then, a weighted choice on suppliers' incentives to invest and rent-extraction motive.

Finally, the parent firm decision problem is

$$\begin{gathered} \max \pi_p = \int_0^1 \beta(j) r'(j) dj \\ s.t. \beta(j) \in \beta_v, \beta_o \end{gathered} \tag{10}$$

which following the approach of Antràs and Helpman (2004, 2008)[6], gives us the optimal division of surplus at stage m

$$\beta^*(m) = 1 - \alpha m^{\frac{\alpha-\rho}{\alpha}}. \tag{11}$$

[5]Using the initial condition $r(0) = 0$.

[6]Antràs and Helpman (2004, 2008) consider first the relaxed problem in which the firm could freely choose the function $\beta(m)$ from the whole set of piecewise continuously differentiable real-valued functions rather than from those that only take on values in the set (β_v, β_o).

Therefore the (unconstrained) optimal bargaining share $\beta^*(m)$ is an increasing function of m in the sequential complements case ($\rho > \alpha$), while it is a decreasing function of m in the sequential substitutes case ($\rho < \alpha$) (*Prediction 1*).
Evaluating the connected interval $[0,1]$ of the common organizational form (integration or outsourcing) entails that when $\rho > \alpha$, there exists a unique $m_c^* \in (0,1]$, such that: (i) all production stages $m \in [0, m_c)$ are outsourced; and (ii) all stages $m \in [m_c, 1]$ are integrated within firm boundaries. When, instead, $\rho < \alpha$, there exists a unique $m_s^* \in (0,1]$, such that: (i) all production stages $m \in [0, m_s)$ are integrated; and (ii) all stages $m \in [m_s, 1]$ are outsourced (*Prediction 2*).

3 Data

The population of interest consists of Business Groups (BGs), namely a set of at least two legally autonomous firms, whose economic activity is coordinated through some form of hierarchical control via equity stakes (Altomonte and Rungi, 2013). Therefore the observation unit is a parent controlling affiliates located both domestically or abroad. In what follows we describe the construction of the sample and the variables used in the analysis.

For the purpose of our analysis, we rely both on the Zephyr Database, from which we derive M&A deals, and the Orbis database, from which we are able to track established networks of productive affiliates coordinated by unique parents together with the information on financial accounts[7]. In tracking Global Value Chains established by MNEs we adopt the same procedure as in Altomonte and Rungi (2013), while applying the majority threshold criterion (> 50.01%) in accordance with current international standards (OECD, 2005; UNCTAD, 2009; EUROSTAT, 2007).

Following this procedure we end up with about 17,000 parents controlling more than 320,000 affiliates. However, since the target of our analysis is identified by the organization of production sequences, we focus on Business Groups that are primarily active in manufacturing sector as indicated by the ultimate parent company. Hence, the final sample is made of 4,214 parents controlling 104,720 affiliates. Furthermore, thanks to knowledge of the complete hierarchical structure of each BGs, we are able to separate a stock of 71,005 incumbent affiliates from a flow of 33,715 new affiliates entering into the productive network after 2004 and until 2012 (see Table 3).

In Table 4 we provide a geographical coverage of the manufacturing parent sample by some main countries/areas, required to validate the high flows' concentration between capital-abundant countries, a crucial feature of intra-firm trade flows. Parents are classified by their home country in the second column, while in the third column we report the total number of affiliates they control worldwide, either domestically or abroad, a distinction provided respectively in column 4 (domestic affiliates) and 5 (affiliates abroad, i.e. outward vertical FDI).

[7] Both sources are compiled by Bureau van Dijk, a consultancy firm collecting companies' information for business intelligence. All in all, Zephyr contains information on over one million deals while Orbis includes up-to-date information for over 120 million firms worldwide.

The bulk of BGs originate in OECD countries (80%), with those parents controlling around 90% (96,879 out of 104,720) of affiliates recorded in our data (63,650 of which are affiliates abroad). In addition, EU countries share the largest number of parents (34%) and affiliates (45%) with nearly two third of them located abroad (the same apply for US parents). Non-OECD parents, instead, deeply invest in domestic economies, showing a larger share of domestic affiliates (53%) respect to the mere 34% of developed countries.

Then the average parent controls 24.87 affiliates, it is active in 6.25 countries, started in 1983 and 49% (2,052 out of 4,214) of our BGs are International Groups (i.e. ≥ 1 one foreign affiliate before 2004).

For each parent and affiliate along the control chain we have industry affiliations at the 6-digit NAICS rev. 2007 classification, including both primary and secondary activities. Since our purpose is to analyze the GVC phenomenon we link the above information with measures of downstreamness proposed by AC (2013). The downstreamness of an industry in production processes is the relative location of that industry along the value chain. Respect to industry level analysis, our approach permits to check for the sequentiality of BG's production along the value chains, given that we are able to observe parents and relative affiliates downstreamness. In addition, we potentially let BGs active in more than one sector (one each primary activity), though most of them have only one primary activity (90% i.e. 3,800 out of 4,214). As in AC (2013) we do not have information on the sequencing of stages for individual technologies, and so we turn to the 2002 Input–Output U.S. Tables to obtain average measures of the relative position of each industry in production processes[8]. AC (2013) propose two measures of downstreamness. The first measure is the ratio of the aggregate direct use to the aggregate total use (*DuseTUse*). The second measure of downstreamness (*DownMeasure*) is a weighted index of the average position in the value chain at which an industry's output is used, with the weights being given by the ratio of the use of that industry's output in that position relative to the total output of that industry. We report in Table 5 the ten highest and lowest values of *DUseTUse* and *DownMeasure* across the NAICS rev.2007 manufacturing industries. The industries featuring the lowest downstreamness values tend to be in the processing of aluminium, petrochemical, or copper, while industries with highest values appear to be goods that are near the retail end of the value chain (e.g. footwear and automobile manufacturing). There is also a reassuring degree of agreement, with the two measures sharing five out of the ten bottom industries and six out of the top ten industries.

Therefore, in Table 6 we report some descriptive statistics for downstreamness across different firms. *DuseTuse* measures tend to be closest to final consumers with 0.06 points more than *Downmeasure* and, most notably, parents and affiliates, in terms of mean downstreamness, are very close along the value chain. In addition, the same table shows demand elasticity faced by parent firms. It is required to distinguish between the cases of sequential complements and substitutes identified in the theory. AC (2013) make us of the U.S. import demand elasticities estimated by Broda and Weinstein (2006)[9], assuming that for sufficiently

[8]As in Acemoglu et al. (2009) the use of the US input-output table for the whole set of countries is justified by the assumption that there is a correlation in the input use patterns across countries. More in general, at the basis of the use of a common input-output table there are the assumptions of a common technology frontier and either of a Leontief production function or of factor price equalization.

[9]The use of the US import demand elasticities for the whole set of countries is justified by the assumption of

high (low) values of this average demand elasticity the corresponding input substitutability is low (high)[10].

Finally Table 7 reports summary statistics for a set of measures that in literature have been identified as systematic determinants of the propensity to transact within firm boundaries. First we add firm level variables: the most productive firms (*Productivity*, measured as valued added over employment) have the highest probability to invest abroad, as suggested by Antràs and Helpman (2004); *Capital Intensity* (fixed assets over employment), our measure of headquarter intensity, is positively associated with intrafirm trade (Antràs, 2003); the largest (parent employment *Size* and number of affiliates controlled by parent firm, *Affiliates'number*) and the oldest (*Age*) firms are more prone to face the sunk costs of integration (Blomström and Lipsey, 1991); the already internationalized firms (*International Group*) if own at least one foreign affiliate before 2004 (Greenaway and Kneller, 2007). *Contractibility*, applied to affiliates' activities (i.e. seller industry), is based on the underlying share of products from an industry that are transacted on organized exchanges or are reference-priced according to Rauch (1999) classification, and which thus can be regarded as more easily contractible goods within firm boundaries (Nunn and Trefler, 2008). Country level variables are both associated to affiliates' country of origin and are *Rule of Law*, which reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, and *Entry Cost*, which instead represents cost (as a percentage of income per capita) required to start a business (see Data Appendix for additional variable details).

4 EMPIRICAL ANALYSIS

In order to detect the optimal organization pattern along the value chain outlined by the AC (2013) model, we estimate the following equation:

$$\begin{aligned} Aduse_i = \beta_1 Pduse_i + \beta_2 Prho_i + \beta_3 Pduse_i * Prho_i \\ + \beta_4 Fctrl_i + \beta_5 Cctrl_i + \varepsilon_i \end{aligned} \tag{12}$$

where $Aduse_i$ is the affiliate downstreamness, $Pduse_i$ is the parent downstreamness, $Prho_i$ is the parent demand elasticity, $Pduse_i * Prho_i$ is the interaction term between parent downstreamness and parent demand elasticity, $Fctrl_i$ represents firm level control measures, namely labor productivity, capital intensity, size, affiliates'number, age, international group and contractibility, and $Cctrl_i$ is the country control measures, which are affiliates' country rule of law and affiliates' country entry cost, and finally ε_i is the usual error term.

Table 8 reveals that parent relative position in value chain, as measured by *DuseTuse*, highly affects its choice over affiliates' downstreamness; as in Alfaro and Charlton (2009) each

same consumer's preferences across countries.

[10] As in AC (2013) we suppose that any existing cross-sectoral variation in input substitutability is largely uncorrelated with the elasticity of demand faced by the parent.

firm and its supplier tend to be very close along the value chain when the decision to be vertically integrated occurs (results are consistent both with and without affiliates' country fixed effects) (Columns 1 and 2, Table 8). This result can also be linked to a further line of research established by Hymer (1976), claiming that search for market power is a further motive for foreign takeovers (further work is needed to control also for this). We find that the higher the demand elasticity faced by parent firm (*rho*), the more upstream are the supplying affiliates. Following the guidance of AC (2013) we also include the interaction of *DUse_TUse* with *rho*. Here the empirical results are supportive of the model's central prediction: the effect of elasticity is positive and significant at the 1% level when parent downstreamness is taken into account. Thus, when parent is downstream and it faces a sufficiently elastic final good demand, integration occurs close to final consumers, letting outsourcing in upstream stages, in order to incentivize these suppliers' investment effort. It is also interesting note that the more productive parents choose downstream affiliates, differently from capital intensive firms (i.e. *capital intensity* is negative and significant at the 1% level); if the group is already internationalized (*int. group* is negative, though not constantly significant), an improved contractibility environment in affilites' country of origin occurs (*contractibility* is negative and significant at the 1% level) and a country exhibits low cost required to start a business (*entry cost* is negative) parent firm integrates relatively upstream (resource-seeking motive, Dunning and Lundan (2008)); finally, largest (*size*) and youngest (age^2) parents choose relatively downstream affiliates (columns 1 and 2, Table 8).

Columns 3 and 4 make use of *DownMeasure*; parent downstreamness is still positive and signifcant. However, both *parent_rho* and *rho*down*, loose some statistical signficance and switch signs. This could hint some forms of non-linearities along value chains which can be further investigated by quantile regressions in Table 9 (most of control variables preserve the same sign). The different results from the OLS vis-à-vis the QREG indicate that estimating only the conditional mean of the response variable can be inappropriate when *DownMeasure* identifies short as opposed to long chains (columns 3 and 4, Table 9). The quantile regression results show, indeed, that the effects of demand elasticity and interaction term variables differ across the quantiles in the conditional distribution of affiliates' downstreamness. To reveal this, the effects for all quantiles are visualized in Figures 1 and 2 for the specifications in Columns 3 and 4 of Table 9, respectively[11]. We are particularly interested in how the effect of a demand elasticity mechanism varies with the quantiles. Note that we only report the findings for downstreamness and elasticity variables, for parsimony and given our theoretical focus, and not for the control variables. We plot their coefficients along the vertical axis and the affiliates' downstreamness quantiles along the horizontal axis. The line in the middle of the shaded area reflects the coefficient estimates of the quantile regression in different quantiles[12]. Figures 1 and 2 show that the demand elasticity (*parent rho*) has a positive effect on affiliates' downstreamness between 0.4 and 0.8, being negative in all quantiles above the latter and below 0.4 (i.e. our earlier findings are confirmed in very low and high levels of de-

[11] These figures are produced in STATA using the 'grqreg' command after running the 'qreg' command (Azevedo, 2011).

[12] The broken line in each figure gives the standard OLS estimate of the conditional mean effect and the shaded grey area depicts a 95% pointwise confidence band for the quantile regression estimates.

mand elasticity). The interaction term *rho*down* is reversed. All coefficients of the quantile regression are significant, which is indicated by the very narrow band of the interval of confidence. Here, the quantile regression analysis reveals that the effect of the demand elasticity is different across quantiles indeed. In a standard OLS regression, this cannot be revealed as only a single estimate is produced, which is conditional on the mean.

4.1 Robustness Checks

We turn next to address potential criticisms regarding the endogenous decision to invest abroad. Because only few firms are able to sustain the higher sunk costs of Foreing Direct Investments (FDI), we suspect endogeneity in the above estimates[13]. To deal with sample selection we indeed make use of the two step Heckman procedure. The two-step procedure is the most common method for estimating the Heckman model and is as follows:

1. Selection equation: estimates the probit equation by MLE and for each observation in the selected sample, computes the inverse Mills ratio λ.

2. Outcome equation: estimates β by OLS of y on x and λ.

The estimators from this two-step procedure, often called "Heckit model", are consistent and asymptotically normal (Heckman, 1979). The advantage of the Heckman model is that it can deal effectively with the zero investment observations and also allows to distinguish between "new" and "old" affiliates.
Our first step, the selection equation is the following:

$$Invesment_i = \beta_1 Affiliates' Number_i + \varepsilon_i \tag{13}$$

where $Investment_i$ is a dummy variable equal to 1 if parent firm i has integrated from 2004 a supplier and 0 otherwise, and $Affiliates' Number_i$ is the natural log of the number of affiliates controlled by parent firm i, assumed to influence the investment decision[14]. The importance of firm size in explaining FDI has been widely analyzed in literature. Blomström and Lipsey (1991) argue that firm size only has a threshold effect on foreign investment, an effect on the decision to invest abroad. Once, however, a firm has jumped the initial barriers to foreign production, size has no effect on the fraction of the firm's resources devoted to foreign activity. Among firms that invest in foreign production large firms do not appear to have any particular advantage over small investing firms.
The outcome equation is then:

$$\begin{aligned} Aduse_i = \beta_1 Pduse_i + \beta_2 Prho_i + \beta_3 Pduse_i * Prho_i \\ + \beta_4 Fctrl_i + \beta_5 Cctrl_i + \varepsilon_i \end{aligned} \tag{14}$$

[13] Ramsey test does not reject the null of endogeneity (omitted variables bias) where the p-value is lower than the usual threshold of 0.05 (95% significance).

[14] We further extensively consider this selection mechanism.

Results are shown in Tables 10 and 11. The significance of λ coefficients in Column 3 confirms the selection bias, which is partly explained by the *affiliates' number* variable (Column 2). Columns 1 and 4 consistently confirm the OLS estimates on parent downstreamness, as well as on productivity, capital intensity, size, age, int.group, contractibility and entry cost. In addition, higher *rho* values (demand elasticity faced by parent firm) are associated with affiliates further from final consumers and the interaction term (*rho*duse*) is positive and significant at the 1%. Once again *DownMeasure* estimates return contradictory results (Table 11).

Furthermore, we investigate an alternative selection mechanism, identified by the heterogeneity proposition à la Antràs and Helpman (2004): the most productive, capital intensive and largest firms have the highest probability to vertically integrate (selection equation in Columns 2 and 5 of Tables 12 and 13). Here the outcome equation reassuringly corroborates our earlier findings on how parent position along the value chain and demand elasticity influence the integration choice (Columns 1 and 4 of Tables 12 and 13).

5 Conclusion

In this paper, we developed an empirical model to test the organizational decisions of multinational firms organizing themselves around Global Value Chains. We rely on the theoretical framework set by Antràs and Chor (2013) for which firm's "make-or-buy" decision depends on the position of a firm along a sequence of productive stages forming a unique supply chain before reaching the final consumers. In this context, the decision to integrate or not an activity depends also on the relative magnitude of the elasticity between the supplier's activity and the established activity of the multinational enterprise.

We find that when demand elasticity is high and a parent firm's activity is relatively downstream, the latter chooses to vertically integrate downstream stages, acquiring suppliers active in processes that are proximate on the supply chain, hence sourcing from outside the firm boundary more upstream stages.

For our analysis we relied on a novel network approach that best fits the theoretical framework. At the same time we track hierarchies of firms organized by multinational enterprises while linking them to the measure of downstreamness once taking into account their industrial activities. In this way we are able to test at the firm-level the governance of multinational enterprises and their decision to integrate suppliers. Thus, differently from the empirical analysis already included in AC (2013), but at the industry-level, we are able to catch the microeconomic dimensions of the phenomenon. Our findings corroborate the key predictions of the theoretical framework while giving some new insights on the sourcing decisions after controlling for additional firm-level characteristics.

A Table Appendix

Table 1: Sequential Substitutes

0 0.5	1
	Sony
Integration *(Affiliate)*	*Outsourcing*

Table 2: Sequential Complements

0	0.7 1
	J&J
Outsourcing	*Integration* *(Affiliate)*

Table 3: Business Groups by Parents and Affiliates

	Parent	**Affiliates (A)+(B)**	**Affiliates Stock (A)**	**Affiliates Investment (B)**
All sectors	17561	324397	196139	128258
Manufacturing	4214	104720	71005	33715

Table 4: Geographic coverage of Business Groups

Economy	**Parents**	**Affiliates (A) + (B)**	**Affiliates Domestic (A)**	**Affiliates Abroad (B)**
OECD	3371	96879	33229	63650
non-OECD	843	7841	4158	3683
EU	1421	47246	15606	31640
US	1407	33660	11027	22633
RoW	1386	23814	10754	13060
Total	4214	104720	37387	67333

Table 5: DUseTUse and DownMeasure across the NAICS rev.2007 manufacturing industries

NAICS	INDUSTRY LABEL	DUSE	NAICS	INDUSTRY LABEL	DOWN
	Lowest 10 values			***Lowest 10 values***	
331314	Secondary Smelting and Alloying of Aluminum	0.0000	325110	Petrochemical Manufacturing	0.2150
325110	Petrochemical Manufacturing	0.0599	331411	Primary Smelting and Refining of Copper	0.2296
331411	Primary Smelting and Refining of Copper	0.0741	331314	Secondary Smelting and Alloying of Aluminum	0.2461
336112	Light Truck and Utility Vehicle Manufacturing	0.0814	325191	Gum and Wood Chemical Manufacturing	0.2595
325211	Electric Housewares and Household Fan Man.	0.1205	325192	Cyclic Crude and Intermediate Manufacturing	0.2595
325910	Printing Ink Manufacturing	0.1325	325193	Ethyl Alcohol Manufacturing	0.2595
311119	Other Animal Food Manufacturing	0.1385	325199	All Other Basic Organic Chemical Man.	0.2595
333220	Plastics and Rubber Industry Machinery Man.	0.1420	331312	Primary Aluminum Production	0.2622
331311	Alumina Refining	0.1447	331311	Alumina Refining	0.2622
331312	Primary Aluminum Production	0.1447	325311	Nitrogenous Fertilizer Manufacturing	0.2658
	Highest 10 values			***Highest 10 values***	
337122	Nonupholstered Wood Household Furniture M.	0.9922	336213	Motor Home Manufacturing	0.9879
339116	Dental Laboratories	0.9942	316211	Rubber and Plastics Footwear Man.	0.9927
332992	Small Arms Ammunition Manufacturing	0.9955	316212	House Slipper Manufacturing	0.9927
332993	Ammunition (except Small Arms) Man.	0.9955	316213	Men's Footwear (except Athletic) Man.	0.9927
316211	Rubber and Plastics Footwear Man.	0.9967	316214	Women's Footwear (except Athletic) Man.	0.9927
316212	House Slipper Manufacturing	0.9967	316219	Other Footwear Manufacturing	0.9927
316213	Men's Footwear (except Athletic) Man.	0.9967	337121	Upholstered Household Furniture Man.	0.9928
316214	Women's Footwear (except Athletic) Man.	0.9967	337122	Nonupholstered Wood Household Furniture M.	0.9948
316219	Other Footwear Manufacturing	0.9967	336112	Light Truck and Utility Vehicle Man.	0.9995
336111	Automobile Manufacturing	0.9997	336111	Automobile Manufacturing	0.9997

Table 6: Downstreamness and Elasticity across firms

		Obs.	Mean	Median	St.dev.	Min	Max
Parent	*DUseTUse*	4201	0.63	0.65	0.22	0.07	0.99
	Downmeasure	4201	0.57	0.56	0.21	0.23	0.99
	Elasticity	4201	8.85	5.97	9.98	1.30	108.50
Affiliate	*DUseTuse*	90298	0.58	0.54	0.16	0.01	1
	Downmeasure	90298	0.52	0.53	0.18	0.21	0.99

Table 7: Control variables

	Obs.	Mean	St.dev.	Min	Max
ln(Productivity)	2438	4.32	1.10	-3.82	11.72
ln(Capital Intensity)	2623	4.90	1.30	-3.18	13.39
ln(Size)	3140	6.80	2.35	0	12.81
ln(Affiliates'number)	4214	2.63	1.78	0	6.91
ln(Age)	4143	3.25	0.91	0	5.90
International Group	4214	0.49	0 50	0	1
Affiliate Contractibility	46630	0.03	0.12	0	1
Country rule of law	86349	0.74	0.16	0.13	0.89
Country entry cost	85564	1.50	1.56	-6.91	7.63

Table 8: OLS investment

VARIABLES	(1) affiliate duse	(2) affiliate duse	(3) affiliate down	(4) affiliate down
parent duse	0.242***	0.252***		
	(0.0133)	(0.0115)		
parent down			0.309***	0.325***
			(0.0155)	(0.0130)
parent rho	-0.00221***	-0.00303***	0.00173**	0.000232
	(0.000700)	(0.000623)	(0.000811)	(0.000676)
rho*duse	0.00277***	0.00368***		
	(0.000897)	(0.000795)		
rho*down			-0.00221*	-0.000389
			(0.00124)	(0.00102)
productivity	0.0103***	0.00818***	0.0175***	0.0137***
	(0.00248)	(0.00212)	(0.00288)	(0.00253)
capital intensity	-0.0106***	-0.00931***	-0.0198***	-0.0172***
	(0.00239)	(0.00212)	(0.00264)	(0.00232)
size	0.00753***	0.00627***	0.00385***	0.00174
	(0.00136)	(0.00123)	(0.00148)	(0.00133)
affiliates'number	-0.0118***	-0.00716***	-0.00561***	-0.00314**
	(0.00163)	(0.00146)	(0.00169)	(0.00150)
age	-0.0355***	-0.0233**	0.0195	0.0246**
	(0.0120)	(0.0105)	(0.0131)	(0.0111)
age^2	0.00482***	0.00277*	-0.00347*	-0.00435***
	(0.00169)	(0.00149)	(0.00183)	(0.00157)
int. group	-0.00439	-0.01060*	-0.00684	-0.00176
	(0.00671)	(0.00605)	(0.00722)	(0.00639)
contractibility	-0.200***	-0.201***	-0.136***	-0.138***
	(0.0201)	(0.0171)	(0.0131)	(0.0120)
rule law	0.0107		0.0126	
	(0.0135)		(0.0142)	
entry cost	-0.00413***		-0.00146	
	(0.00142)		(0.00165)	
Constant	0.517***	0.209***	0.341***	0.279***
	(0.0277)	(0.0279)	(0.0300)	(0.0271)
Country dummies	NO	YES	NO	YES
Observations	8,404	11,732	8,404	11,732
R-squared	0.152	0.176	0.125	0.160

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 9: QREG investment

VARIABLES	(1) affiliate duse	(2) affiliate duse	(3) affiliate down	(4) affiliate down
parent duse	0.288***	0.297***		
	(0.00991)	(0.00417)		
parent down			0.480***	0.569***
			(0.0169)	(0.0123)
parent rho	-0.00199***	-0.00269***	0.00342***	0.00314***
	(0.000550)	(0.000240)	(0.000944)	(0.000693)
rho*duse	0.00253***	0.00340***		
	(0.000694)	(0.000302)		
rho*down			-0.00625***	-0.00607***
			(0.00143)	(0.00104)
productivity	0.00478**	0.00943***	0.0112***	0.00915***
	(0.00216)	(0.000913)	(0.00332)	(0.00241)
capital intensity	-0.0102***	-0.0136***	-0.0192***	-0.0152***
	(0.00195)	(0.000846)	(0.00300)	(0.00225)
size	0.00671***	0.00616***	-6.57e-05	0.000398
	(0.00110)	(0.000482)	(0.00168)	(0.00127)
affiliates'number	-0.0140***	-0.00785***	-0.00274	0.000234
	(0.00133)	(0.000565)	(0.00204)	(0.00149)
age	-0.0442***	-0.0496***	0.0308**	0.0197*
	(0.00971)	(0.00412)	(0.0148)	(0.0109)
age^2	0.00651***	0.00667***	-0.00464**	-0.00337**
	(0.00136)	(0.000582)	(0.00208)	(0.00153)
int. group	0.00151	-0.00773***	0.00770	0.000121
	(0.00536)	(0.00239)	(0.00819)	(0.00628)
contractibility	-0.226***	-0.204***	-0.118***	-0.117***
	(0.0133)	(0.00597)	(0.0204)	(0.0156)
rule law	-0.0235**		-0.00674	
	(0.0107)		(0.0164)	
entry cost	-0.00778***		-0.00412**	
	(0.00118)		(0.00180)	
Constant	0.556***	0.260***	0.240***	0.166***
	(0.0226)	(0.0108)	(0.0343)	(0.0283)
Country dummies	NO	YES	NO	YES
Observations	8,404	11,732	8,404	11,732
Pseudo R-squared	0.0859	0.1076	0.0664	0.1022

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Figure 1: QREG DOWN investment

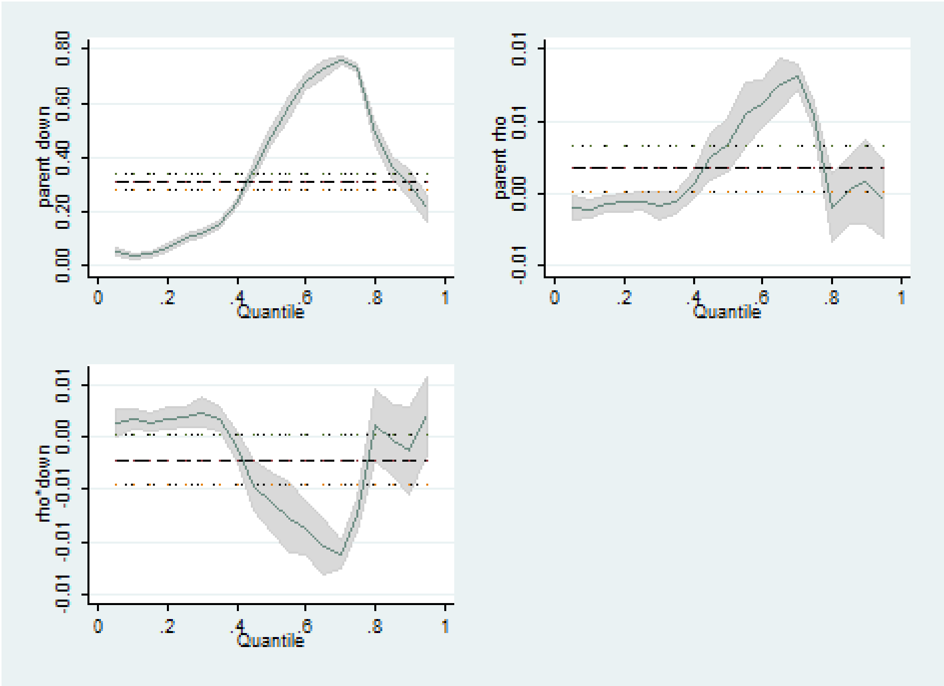

Figure 2: QREG DOWN FE investment

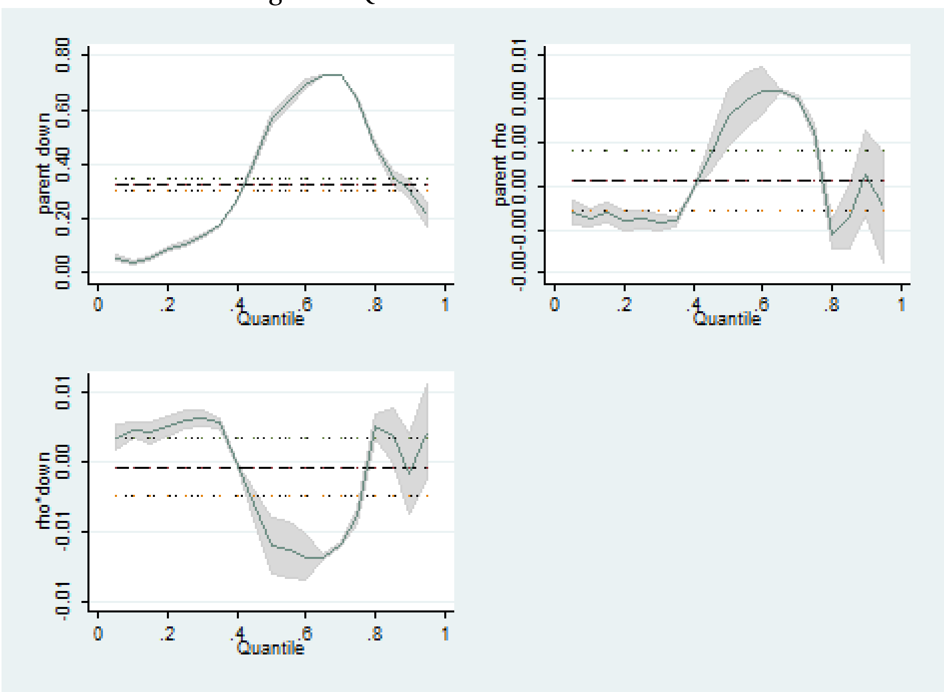

Table 10: Heckit 1 dusetuse

VARIABLES	(1) affiliate duse	(2) investment	(3) mills	(4) affiliate duse	(5) investment	(6) mills
parent duse	0.243***			0.253***		
	(0.0123)			(0.0106)		
parent rho	-0.00216***			-0.00296***		
	(0.000685)			(0.000608)		
rho*duse	0.00269***			0.00358***		
	(0.000865)			(0.000767)		
productivity	0.00998***			0.00796***		
	(0.00269)			(0.00232)		
capital intensity	-0.0114***			-0.00973***		
	(0.00241)			(0.00215)		
size	0.00575***			0.00510***		
	(0.00124)			(0.00110)		
age	-0.0339***			-0.0218**		
	(0.0121)			(0.0105)		
age^2	0.00451***			0.00251*		
	(0.00170)			(0.00149)		
int. group	-0.00182			-0.00800		
	(0.00675)			(0.00619)		
contractibility	-0.200***			-0.201***		
	(0.0167)			(0.0151)		
rule law	0.0101					
	(0.0133)					
entry cost	-0.00407***					
	(0.00146)					
affiliates'number		0.650***			0.670***	
		(0.00515)			(0.00482)	
lambda			0.0259***			0.0168***
			(0.00389)			(0.00344)
Constant	0.460***	-2.638***		0.124	-2.527***	
	(0.0309)	(0.0169)		(0.173)	(0.0154)	
Country dummies	NO			YES		
Observations	51,821	51,821	51,821	55,149	55,149	55,149
Wald chi^2	1418.52			2449.73		
Prob > chi^2	0.0000			0.0000		

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 11: Heckit 2 downmeasure

VARIABLES	(1) affiliate down	(2) investment	(3) mills	(4) affiliate down	(5) investment	(6) mills
parent down	0.310***			0.325***		
	(0.0147)			(0.0125)		
parent rho	0.00172**			0.000208		
	(0.000827)			(0.000707)		
rho*down	-0.00222*			-0.000372		
	(0.00125)			(0.00106)		
productivity	0.0172***			0.0135***		
	(0.00290)			(0.00244)		
capital intensity	-0.0208***			-0.0179***		
	(0.00260)			(0.00227)		
size	0.00201			0.000366		
	(0.00134)			(0.00115)		
age	0.0198			0.0252**		
	(0.0130)			(0.0110)		
age^2	-0.00359**			-0.00447***		
	(0.00182)			(0.00156)		
int. group	-0.00836			-0.00338		
	(0.00727)			(0.00650)		
contractibility	-0.136***			-0.137***		
	(0.0179)			(0.0159)		
rule law	0.0127					
	(0.0143)					
entry cost	-0.00139					
	(0.00157)					
affiliates'number		0.650***			0.670***	
		(0.00515)			(0.00482)	
lambda			0.00648			0.00196
			(0.00418)			(0.00361)
Constant	0.335***	-2.638***		0.200	-2.527***	
	(0.0330)	(0.0169)		(0.181)	(0.0154)	
Country dummies	NO			YES		
Observations	51,821	51,821	51,821	55,149	55,149	55,149
Wald chi^2	1180.10			2216.86		
Prob > chi^2	0.0000			0.0000		

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 12: Heckit 3 dusetuse (alternative selection eq.)

VARIABLES	(1) affiliate duse	(2) investment	(3) mills	(4) affiliate duse	(5) investment	(6) mills
parent duse	0.244***			0.254***		
	(0.0123)			(0.0106)		
parent rho	-0.00260***			-0.00326***		
	(0.000684)			(0.000606)		
rho*duse	0.00314***			0.00393***		
	(0.000865)			(0.000766)		
int. group	-0.00142			-0.00488		
	(0.00703)			(0.00645)		
contractibility	-0.206***			-0.205***		
	(0.0167)			(0.0151)		
rule law	0.00538					
	(0.0132)					
entry cost	-0.00421***					
	(0.00147)					
affiliates'number		0.319***			0.312***	
		(0.00948)			(0.00891)	
productivity		0.164***			0.167***	
		(0.0139)			(0.0127)	
capital intensity		0.137***			0.158***	
		(0.0125)			(0.0116)	
size		0.340***			0.363***	
		(0.00741)			(0.00687)	
age		0.00179			0.0528	
		(0.0718)			(0.0676)	
age^2		-0.00631			-0.0210**	
		(0.0110)			(0.0104)	
lambda			0.0142***			0.0102**
			(0.00429)			(0.00407)
Constant	0.453***	-4.838***		0.113	-4.929***	
	(0.0148)	(0.140)		(0.172)	(0.131)	
Country dummies	NO			YES		
Observations	25,406	25,406	25,406	28,734	28,734	28,734
Wald chi^2	1358.06			2397.25		
Prob > chi^2	0.0000			0.0000		

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 13: Heckit 4 downmeasure (alternative selection eq.)

VARIABLES	(1) affiliate down	(2) investment	(3) mills	(4) affiliate down	(5) investment	(6) mills
parent down	0.311***			0.325***		
	(0.0147)			(0.0125)		
parent rho	0.000964			-0.000334		
	(0.000820)			(0.000700)		
rho*down	-0.00121			0.000379		
	(0.00124)			(0.00105)		
int. group	-0.0132*			-0.00443		
	(0.00756)			(0.00678)		
contractibility	-0.146***			-0.146***		
	(0.0179)			(0.0159)		
rule law	0.0176					
	(0.0142)					
entry cost	-0.00153					
	(0.00158)					
affiliates'number		0.319***			0.312***	
		(0.00948)			(0.00891)	
productivity		0.164***			0.167***	
		(0.0139)			(0.0127)	
capital intensity		0.137***			0.158***	
		(0.0125)			(0.0116)	
employment		0.340***			0.363***	
		(0.00741)			(0.00687)	
age		0.00179			0.0528	
		(0.0718)			(0.0676)	
age^2		-0.00631			-0.0210**	
		(0.0110)			(0.0104)	
lambda			0.00379			0.00853**
			(0.00461)			(0.00427)
Constant	0.347***	-4.838***		0.198	-4.929***	
	(0.0155)	(0.140)		(0.180)	(0.131)	
Country dummies	NO			YES		
Observations	25,406	25,406	25,406	28,734	28,734	28,734
Wald chi^2	1095.32			2123.15		
Prob > chi^2	0.0000			0.0000		

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

B DATA APPENDIX

Downstreamness: computed by AC(2013) from the 2002 U.S. I–O Tables using the detailed Supplementary Use Table after redefinitions issued by the BEA 2002, to obtain average measures of the relative position of each industry in U.S. production processes. AC(2013) propose two measures of downstreamness. The first measure is the ratio of the aggregate direct use to the aggregate total use *(DUseTUse)* of a particular industry i's goods, where the direct use for a pair of industries is the value of goods from industry *i* directly used by firms in industry *j* to produce goods for final use, while the total use for is the value of goods from industry *i* used either directly or indirectly in producing industry *j*'s output for final use. A high value of *DUseTUse* thus suggests that most of the contribution of input *i* tends to occur at relatively downstream production stages that are close to final demand. The second measure of downstreamness *(DownMeasure)* is a weighted index of the average position in the value chain at which an industry's output is used, with the weights being given by the ratio of the use of that industry's output in that position relative to the total output of that industry. These measures have been finally averaged over the 6-digit NAICS rev.2007 parent and affiliate primary activities.

Demand Elasticity: computed by AC (2013) from U.S. HS10 products import demand elasticities (Broda and Weinstein,2006). These were merged with a comprehensive list of HS10 codes from Pierce and Schott (2012). For each HS10 code missing an elasticity value, they assigned a value equal to the trade-weighted average elasticity of the available HS10 codes with which it shared the same first nine digits. This was done successively up to codes that shared the same first two digits, to fill in as many HS10 elasticities as possible. Using the IO-HS concordance provided by the BEA with the 2002 U.S. I–O Tables, they then took the trade-weighted average of the HS10 elasticities within each IO2002 category. At each stage, the weights used were the total value of U.S. imports by HS10 code from 1989 to 2006, calculated from Feenstra et al. (2002). There remained 13 IO2002 industries without elasticity values after the above procedure. For these, we assigned a value equal to the weighted average elasticity of the IO2002 codes with which the industry shared the same first four digits, or (if the value was still missing) the same first three digits, using industry output values as weights. This yielded import elasticities for the industry that sells the input in question (*Rho*).

Capital intensity: from the Orbis database. It is the natural log of fixed assets over number of employees for parent firm *i*.

Age: computed from the Orbis database. It is the natural log of 2013 minus foundation's year for parent firm *i*.

Size: from the Orbis database. It is the natural log of number of employees for parent firm *i*.

Productivity: computed from the Orbis database. It is the natural log of value added over number of employees for parent firm *i*.

Affiliates'number: from the Orbis database. It is the natural log of number of affiliates controlled by parent firm *i*.

International Group: from the Orbis database. It is a dummy variable equal to 1 if the parent firm *i* owns at least one foreign affiliate before 2004 and 0 otherwise (if before 2004 parent *i* does not own any affiliate we apply 0).

Investment: from the Orbis database. It is a dummy variable equal to 1 if parent firm *i* has integrated from 2004 to 2012 an affiliate and 0 otherwise.

Contractibility: AC(2013) computed it from the 2002 U.S. I–O Tables, following the methodology of Nunn (2007). For each IO2002 industry, they first calculated the fraction of HS10 constituent codes classified by Rauch (1999) as neither reference-priced nor traded on an organized exchange, under Rauch's "liberal" classification. (The original Rauch classification was for SITC Rev. 2 products; these were associated with HS10 codes using a mapping derived from U.S. imports in Feenstra, Romalis, and Schott (2002).) The authors took 1 minus this value as a measure of the own contractibility of each IO2002 industry. These measure has been averaged over the 6-digit NAICS 2007 affiliate primary activities.

Entry costs: Country entry costs were taken from the Doing Business data set. Data on the number of procedures, number of days, and cost (as a percentage of income per capita) required to start a business were used. These were averaged over 2003–2005 for each affiliates' country of origin.

Rule of law: from the Worldwide Governance Indicators (Kaufmann et al., 2011). The annual index was linearly rescaled form its original range of -2.5 to 2.5. to lie between 0 and 1, and averaged over the period 2004-2010 for each affiliates' country of origin. Reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.

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